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IRON ORES - DETERMINATION OF VANADIUM BY SPECTROPHOTOMETRIC METHOD STATISTICAL EVALUATION OF INTERNATIONAL TEST DATA - 1982

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November 1982

(For submission to the ISO/TC 102/SC 2/WG 19B and to the Secretariat of
ISO/TC 102/SC 2)

Project MRP-3.8.0.0.11
Analytical Methodology

MINERAL RESEARCH PROGRAM
MINERAL SCIENCES LABORATORIES
DIVISION REPORT MRP/MSL 82-123 (IR)

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l'énergie (CANMET).

ISO/TC 102/SC 2 (WG 19B)

November, 1982

IRON ORES - DETERMINATION OF VANADIUM BY
SPECTROPHOTOMETRIC METHOD
STATISTICAL ANALYSIS OF INTERNATIONAL TEST DATA-1982

by

R. Sutarno* and W.S. Bowman**

SUMMARY

The analytical data collected from the international test conducted by ISO/TC 102/SC 2/WG 19B, on the determination of vanadium content in iron ores by spectrophotometric method, during the period 1980-1982 have been statistically evaluated to estimate the precision of the method.

It was found that the precision can be expressed in terms of the vanadium content by the following linear equations:

$$r = 0.0461 X + 0.0015$$

$$P = 0.0919 X + 0.0056$$

$$\sigma_r = 0.0163 X + 0.0005$$

$$\sigma_L = 0.0304 X + 0.0019$$

where r is the repeatability, P is the permissible tolerance, σ_r is the within-laboratory standard deviation, σ_L is the between-laboratories standard deviation and X is the vanadium content in the sample. Eight samples of iron ores containing vanadium from 0.005 to 0.52% were used in this international test. It was noted that the between-laboratories precision is rather poor, which implies that further standardization may be necessary before the analytical method is acceptable as an ISO standard method.

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INTRODUCTION

The analytical data were collected by the convener of ISO/TC 102/SC 2/WG 19B (Technical Committee 102 - Iron Ores, Subcommittee 2 - Chemical Analysis, Working Group 19B - Determination of vanadium by spectrophotometric method) from an international test conducted during the period 1980 - 1982¹. Eight samples of iron ores with vanadium contents ranging from 0.005 to 0.5% were used. Twelve laboratories provided analytical data; each analyzed two bottles of sample of each ore in duplicate.

The purpose of this statistical evaluation is to provide the working group with estimates of the precision in the form of repeatability, permissible tolerance, and within-laboratory and between-laboratories standard deviations.

PRINCIPLE OF ANALYTICAL METHOD

Decomposition of the test portion is accomplished by fusion or sintering with sodium peroxide and leaching with water and sulphuric acid. Copper sulphate and potassium permanganate are added to an aliquot to oxidize vanadium to the quinquevalent state; samples are then treated with BPHA and hydrochloric acid to form a complex which is extracted into chloroform. If the sample contains more than 0.5% Ti, the solution is washed with phosphate solution to extract the titanium. Spectrophotometric measurement of the absorbance is made at approximately 535 nm and compared to absorbance values of calibration solutions treated in the same manner.

STATISTICAL EVALUATION

The analytical data were statistically evaluated using the procedure described in ISO/TC 102/SC 2N 532 E (factor 2.77 has been replaced by 2.83)² in the calculation of repeatability and permissible tolerance. This procedure is schematically illustrated in Figure 1. The raw data are also plotted in Figures 2. The boxed points in these figures signify that these data are suspected outliers and were not used to estimate the grand means and precisions. The estimated precisions are plotted against their

corresponding grand means in Figures 3. In Figure 3.1 the precisions estimated from all eight samples are plotted. In Figure 3.2 the precisions estimated from samples 76-3 and 81-3 (those involving phosphate wash) are excluded. Linear regression equations of these lines were also computed and presented in Tables 1. Table 2 lists suspected outliers and Table 3 shows the comparison between the grand means (and their 95% confidence intervals) and the standard deviations obtained by spectrophotometric method with those obtained by atomic absorption spectrometric method.

OBSERVATIONS

Based on the results of the above evaluation, the following may be inferred:

- (a) Precision - The within-laboratory precision of this method is reasonable. However, the between-laboratories precision can still be improved. σ_L/σ_T ratios are rather high. Furthermore, the number of laboratories reporting results suspected to be outliers is high - all of them due to lack of precision. Some laboratories reported outliers for several samples (Table 2). This may indicate that the analytical method requires further standardization. The between-laboratories precisions derived from samples 76-3 and 81-3 seem to be out of line (Figure 3.1); excluding these samples improved the correlation between the precision and the concentration level.
- (b) Accuracy - Although t-test results show that the difference between the grand means obtained by spectrophotometric method and those by atomic absorption method are statistically insignificant, there is a systematic tendency that the present method produces higher means than those of the atomic absorption method with extraction and lower means than those of the atomic absorption method without extraction.

ABBREVIATIONS USED IN THIS REPORT

σ_r = SIGMA-R - within-laboratory standard deviation
 σ_L = SIGMA-L - between-laboratories standard deviation
 r^* = R-repeatability
= $2.83 \sigma_r$
 P^{**} = permissible tolerance between-laboratories

$$= 2.83 \sqrt{\sigma_L^2 + \sigma_r^2/2}$$

BPHA = N-Benzoylphenylhydroxylamine

COUNTRY ABBREVIATIONS

FR = France
IT = Italy
JP = Japan
SW = Sweden
USA = United States

* Repeatability, r , is the value below which the absolute difference between two independent single test (analysis) results produced by a laboratory on identical material using the same equipment within a short interval of time, using the standardized test method, may be expected to be with a 95% probability.

** Permissible tolerance between laboratories, P , is the value below which the absolute difference between two means of duplicate test results on identical material obtained by operators of different laboratories using the standardized test method, may be expected to lie with a 95% probability.

REFERENCES

1. "Iron Ores - Determination of vanadium content - BPHA Spectrophotometric Method", ISO/TC 102/SC 2 (WG 19B - 5) N 698 E, September, 1982.
2. "Procedures for statistical evaluation of analytical data resulting from international tests", ISO/TC 102/SC 2 (WG 7-21) N 532 E, August, 1978.

Table 1.a

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5

SUMMARY OF PRECISIONS FOR ALL SAMPLES

SAMPLE	MEAN(X)	REPEATABILITY	PERMISSIBLE TOLERANCE	SIGMA-R	SIGMA-L
76-3	.2955	.0155	.0712	.00548	.02485
76-17	.5188	.0251	.0522	.00886	.01735
81-3	.3751	.0227	.0666	.00802	.02283
81-4	.1146	.0095	.0205	.00335	.00685
81-5	.0600	.0033	.0122	.00117	.00424
79-14	.0345	.0017	.0091	.00062	.00319
79-16	.0059	.0027	.0040	.00095	.00124
79-17	.0047	.0009	.0035	.00032	.00120

THE REGRESSION EQUATIONS ARE:

CORR. COEFF.

R	=	.0492 X +	.0015	.9833
P	=	.1288 X +	.0072	.8778
SIGMA-R	=	.0174 X +	.0005	.9834
SIGMA-L	=	.0437 X +	.0025	.8647

Table 1.b

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5

SUMMARY OF PRECISIONS FOR ALL SAMPLES

SAMPLE	MEAN(X)	REPEATABILITY	PERMISSIBLE TOLERANCE	SIGMA-R	SIGMA-L
76-17	.5188	.0251	.0522	.00886	.01735
81-4	.1146	.0095	.0205	.00335	.00685
81-5	.0600	.0033	.0122	.00117	.00424
79-14	.0345	.0017	.0091	.00062	.00319
79-16	.0059	.0027	.0040	.00095	.00124
79-17	.0047	.0009	.0035	.00032	.00120

THE REGRESSION EQUATIONS ARE:

CORR. COEFF.

R	=	.0461 X +	.0015	.9863
P	=	.0919 X +	.0056	.9902
SIGMA-R	=	.0163 X +	.0005	.9864
SIGMA-L	=	.0304 X +	.0019	.9892

Note: Samples 76-3 and 81-3 were excluded from these calculations.

TABLE 2

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC
METHOD ISO/TC102/SC2/WG 19B-5

List of Outliers

Sample	Outliers
79-3	SW 2
76-17	JP 2, SW 2, USA 1
81-3	JP 2, SW 2
81-4	FR 3
81-5	JP 2, SW 2
79-14	FR 2, JP 2, SW 2
79-16	—
79-17	FR 2, FR 3, JP 2, SW 2

TABLE 3

Comparison Between the Means and Precision Obtained from the International Test Data on the Determination of Vanadium by Spectrophotometric Method and Those Obtained by AAS Method

Sample	Mean by Spec. Method			Mean by AAS Method			σ_r		σ_L	
	Low	95 % Confidence Interval X	High	Low	95 % Confidence Interval X	High	Spec.	AAS	Spec.	AAS
				Method 1 (AAS Without Extraction)						
76-3	0.27869	0.29548	0.31228				0.00548		0.02485	
76-17	0.50506	0.51882	0.53259	0.52918	0.54271	0.55624	0.00886	0.00805	0.01735	0.02601
81-3	0.35855	0.37513	0.39171	0.38832	0.40195	0.41557	0.00802	0.00575	0.02283	0.02343
81-4	0.10983	0.11457	0.11930	0.11388	0.11782	0.12176	0.00335	0.00273	0.00685	0.00698
81-5	0.05691	0.06001	0.06311	0.05929	0.06107	0.06284	0.00117	0.00217	0.00424	0.00328
				Method 2 (AAS With Extraction)						
81-5	0.05691	0.06001	0.06311	0.05264	0.05504*	0.05745	0.00117	0.00273	0.00424	0.00306
79-14	0.03197	0.03446	0.03696	0.03078	0.03265*	0.03452	0.00062	0.00101	0.00319	0.00243
79-16	0.00508	0.00594	0.00679	0.00487	0.00523	0.00558	0.00095	0.00041	0.00124	0.00060
79-17	0.00366	0.00469	0.00572	0.00377	0.00400	0.00423	0.00032	0.00035	0.00120	0.00033

*Between-bottles variation is statistically significant.

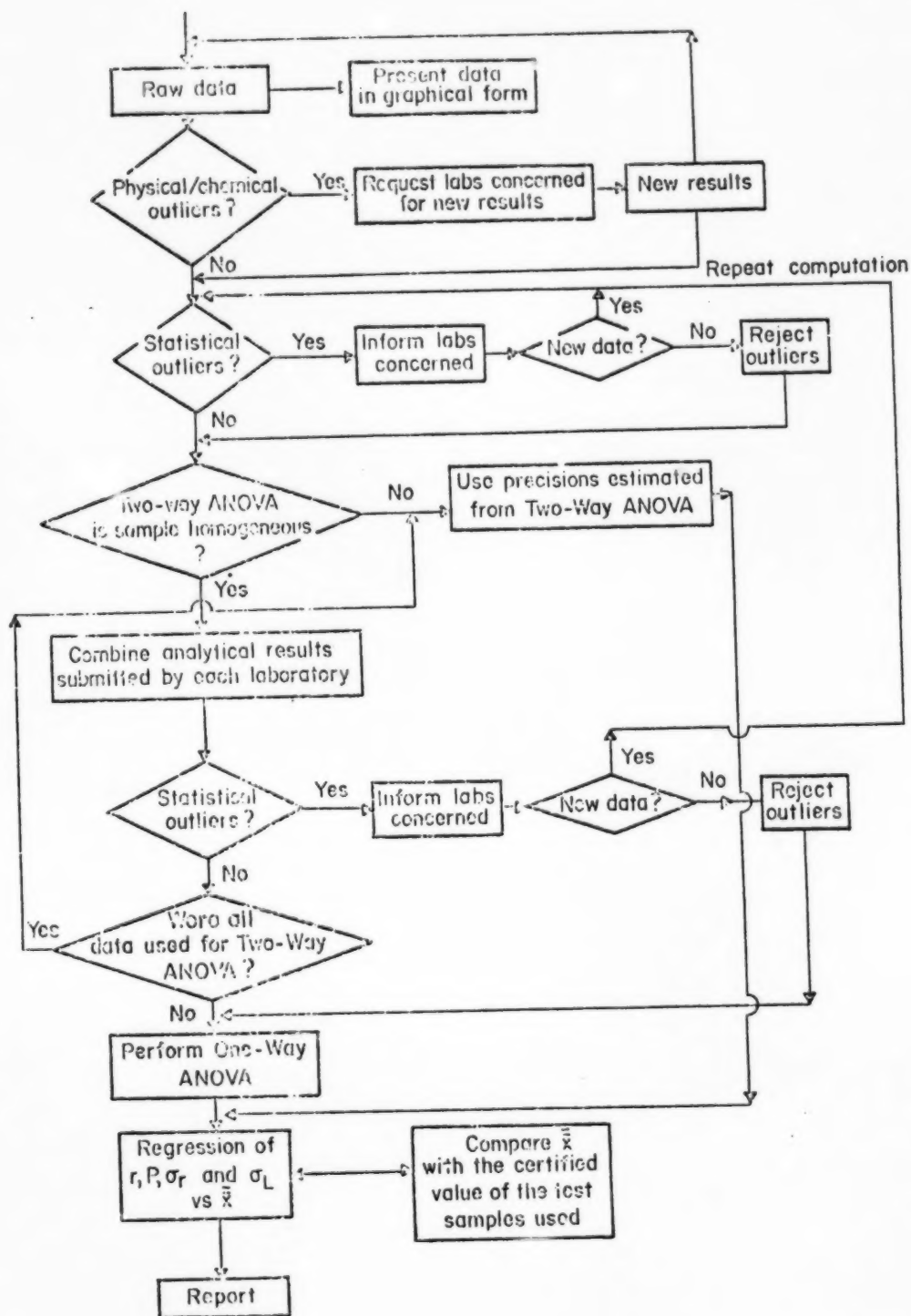
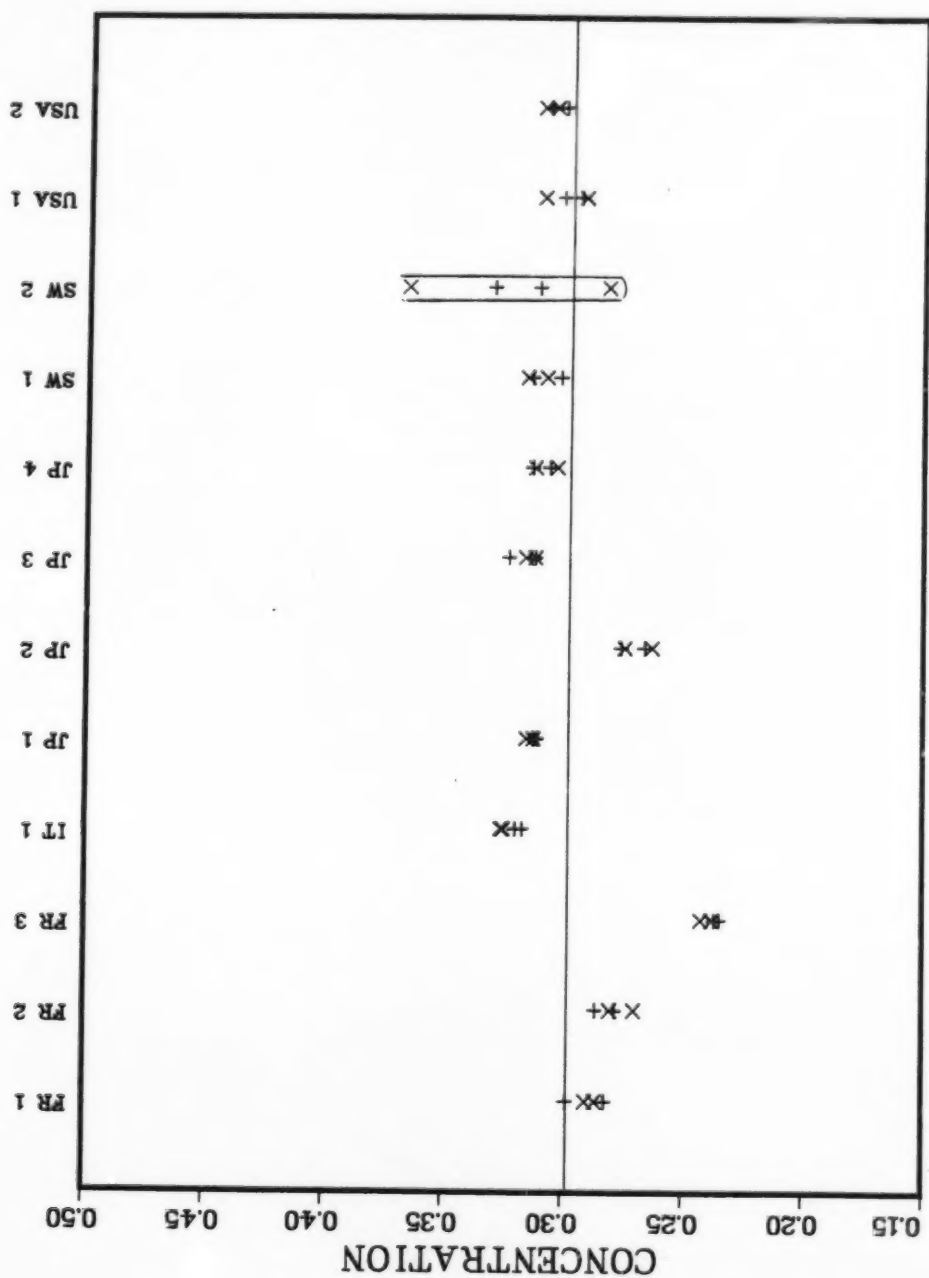


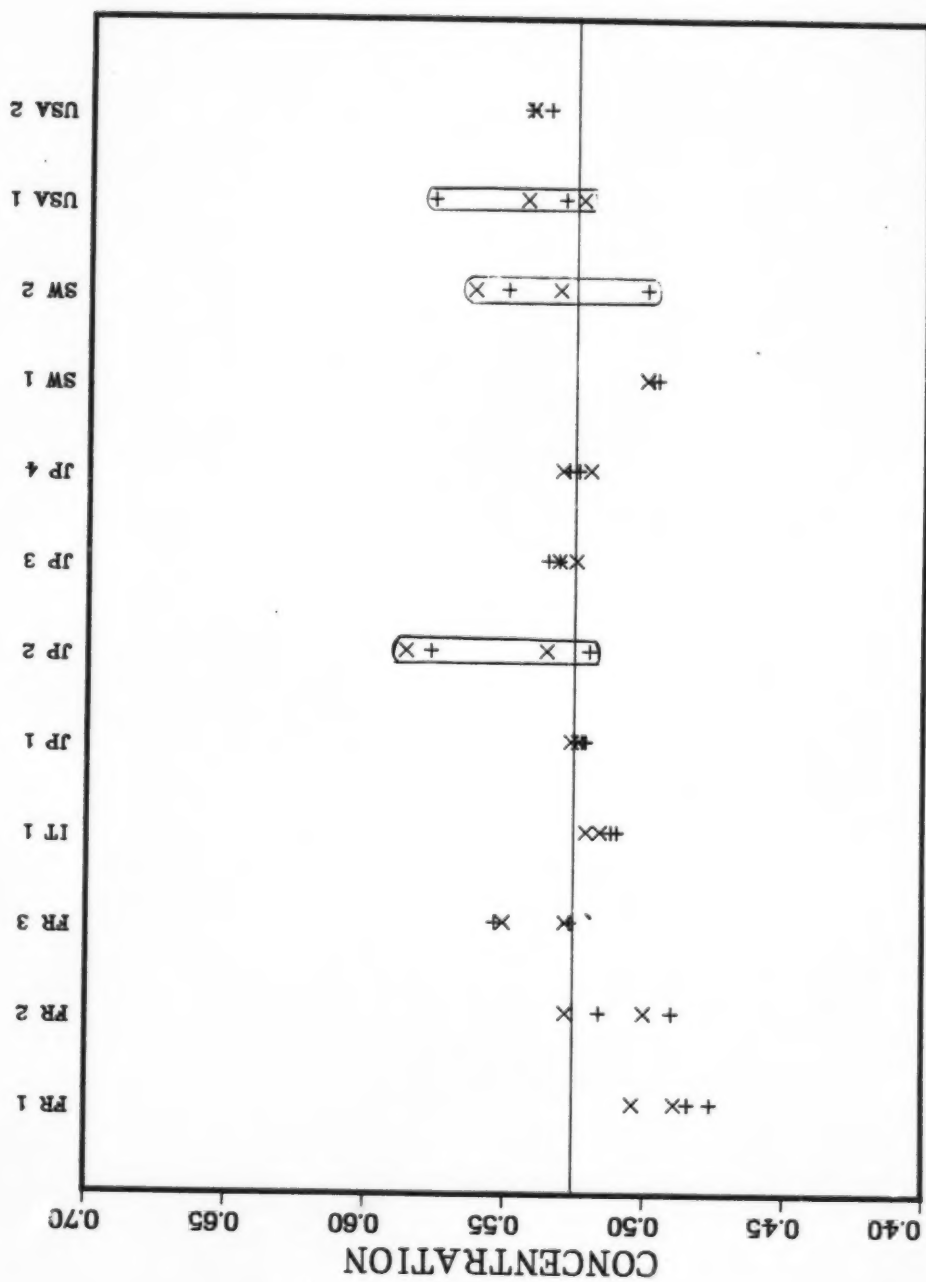
Figure 1. Flow Chart of the Procedure for Statistical Evaluation of Analytical Data Resulting from International Tests.



IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 76-3

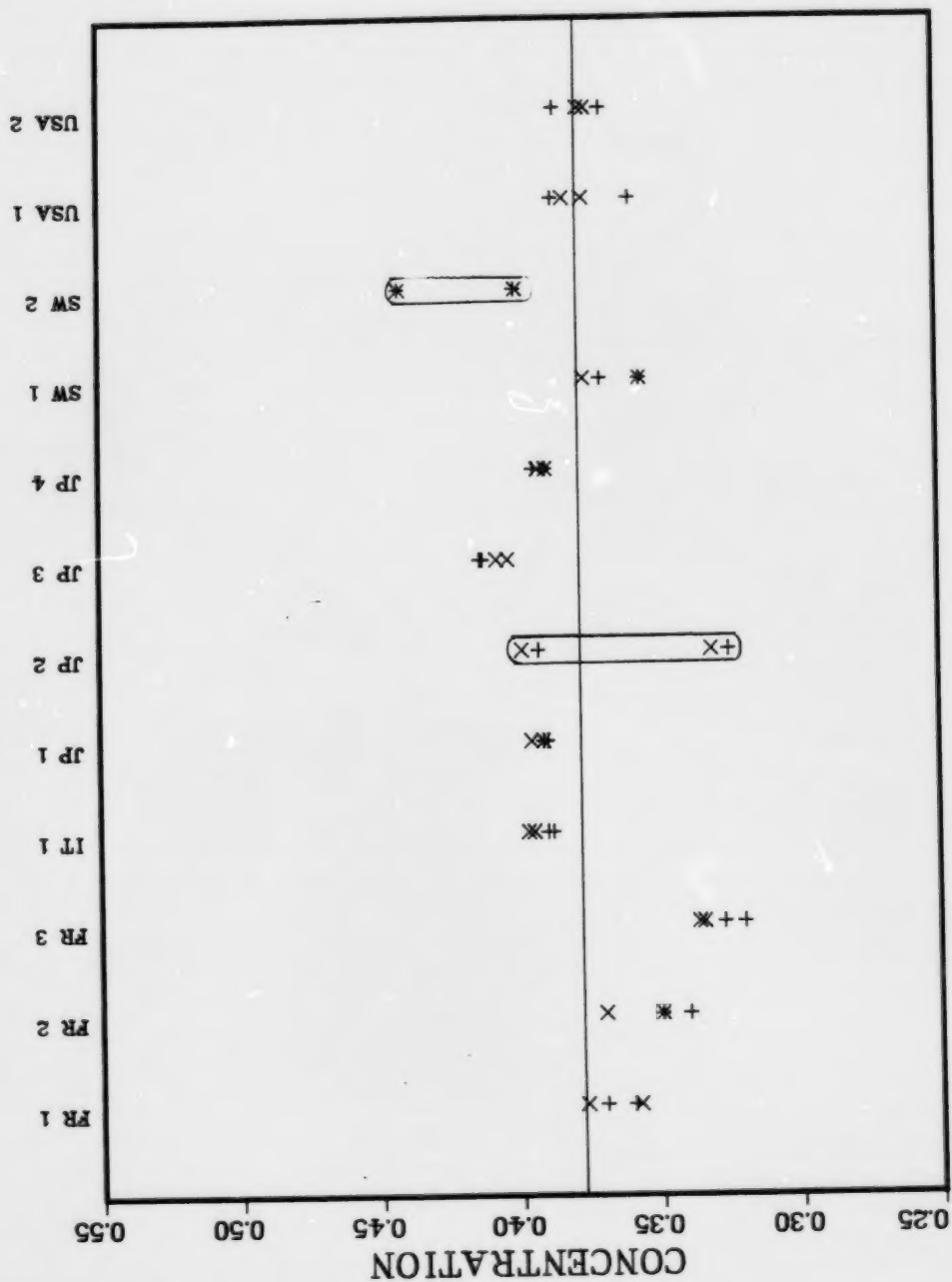
Figure 2.1



IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 76-17

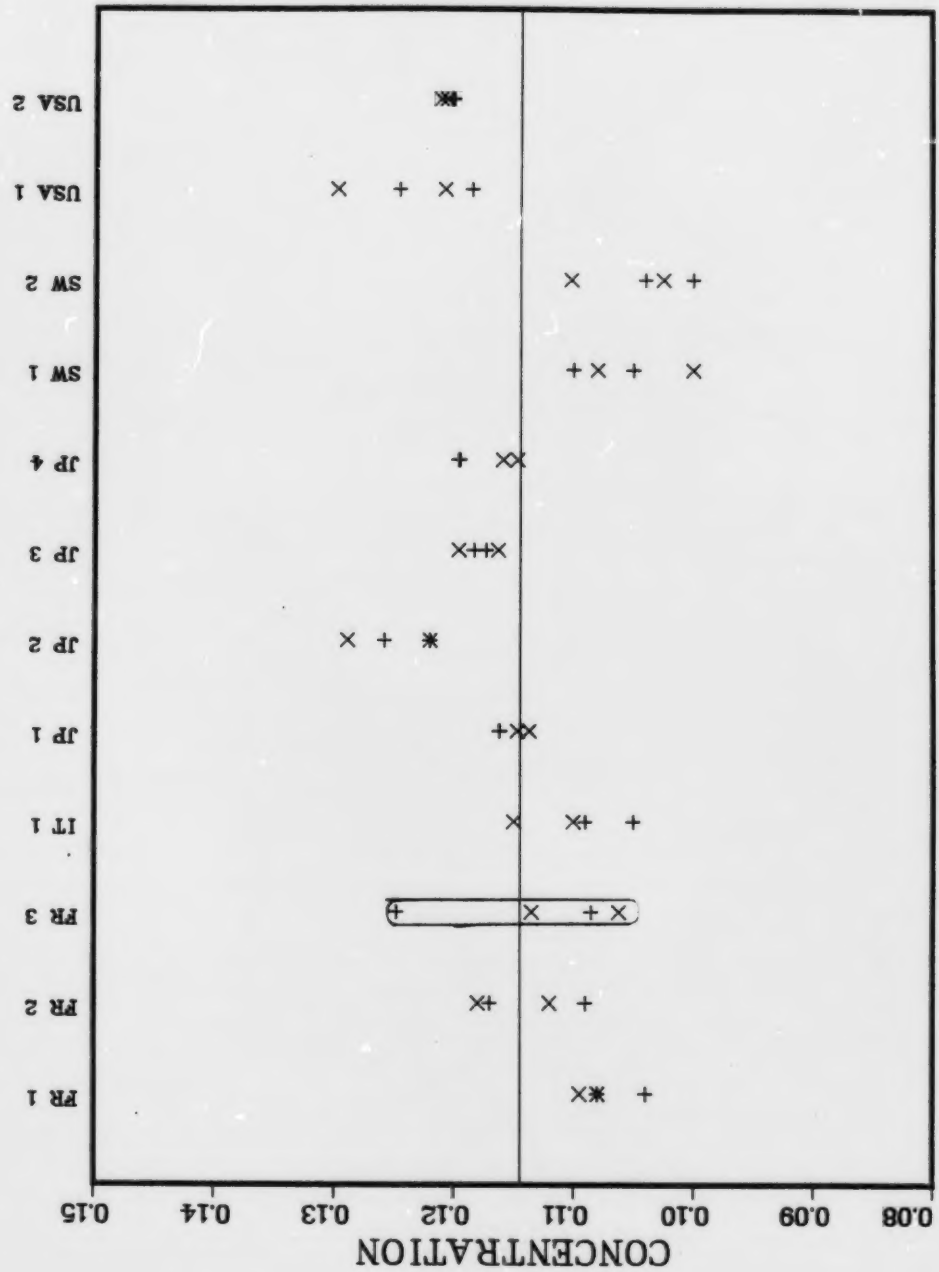
Figure 2.2



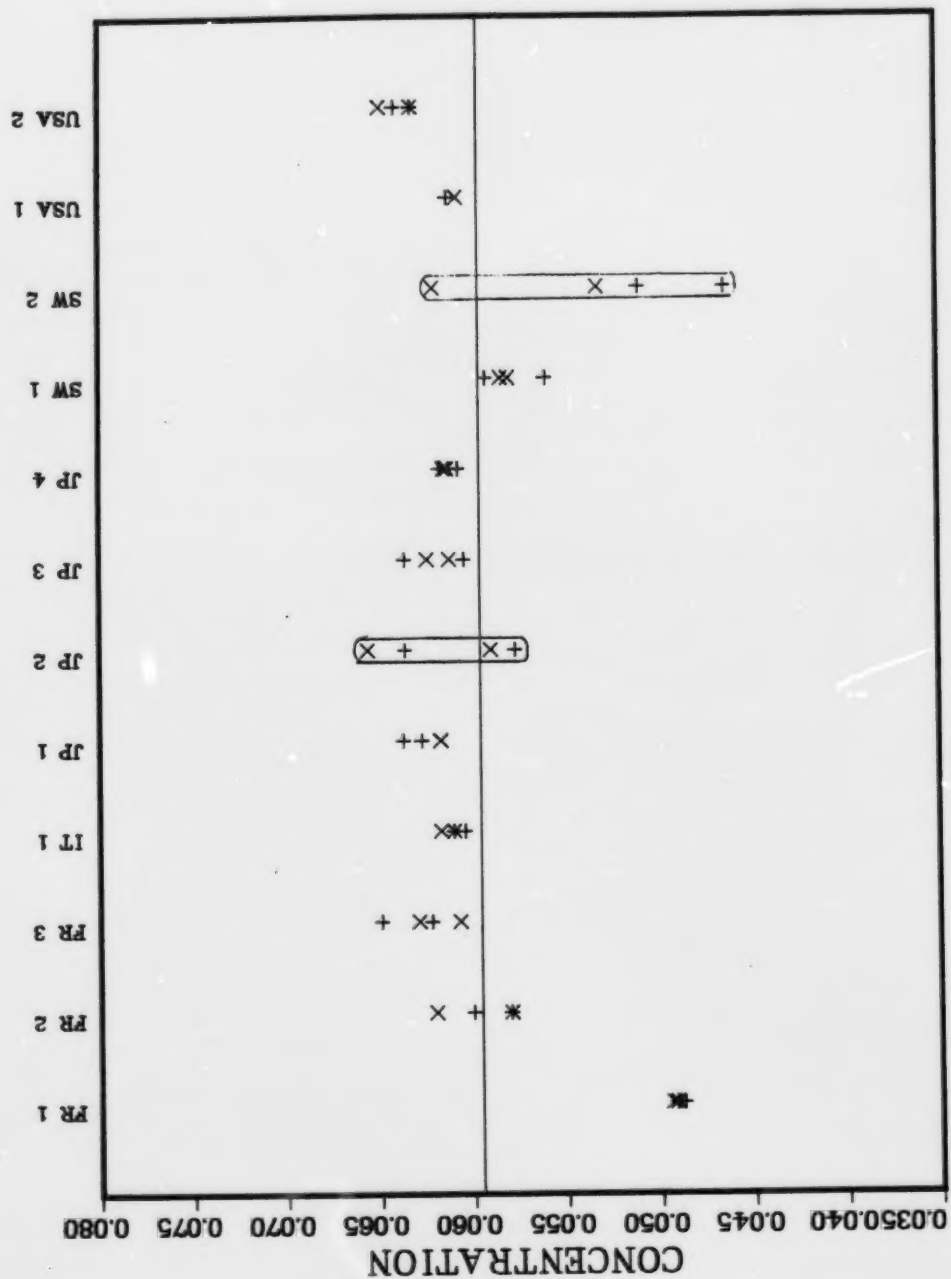
IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 81-3

Figure 2.3



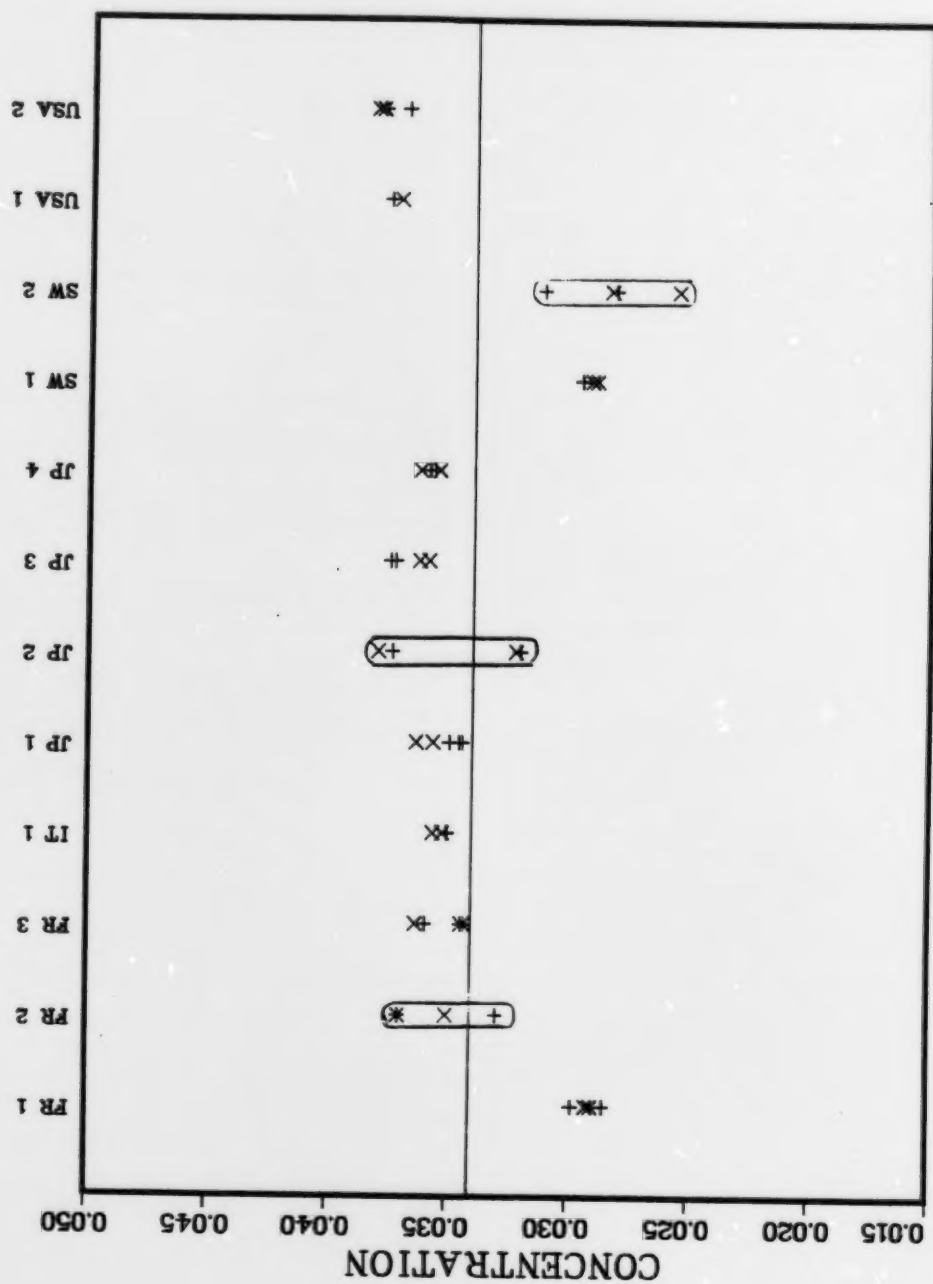
IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5
 SAMPLE 81-4
 Figure 2.4



IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 81-5

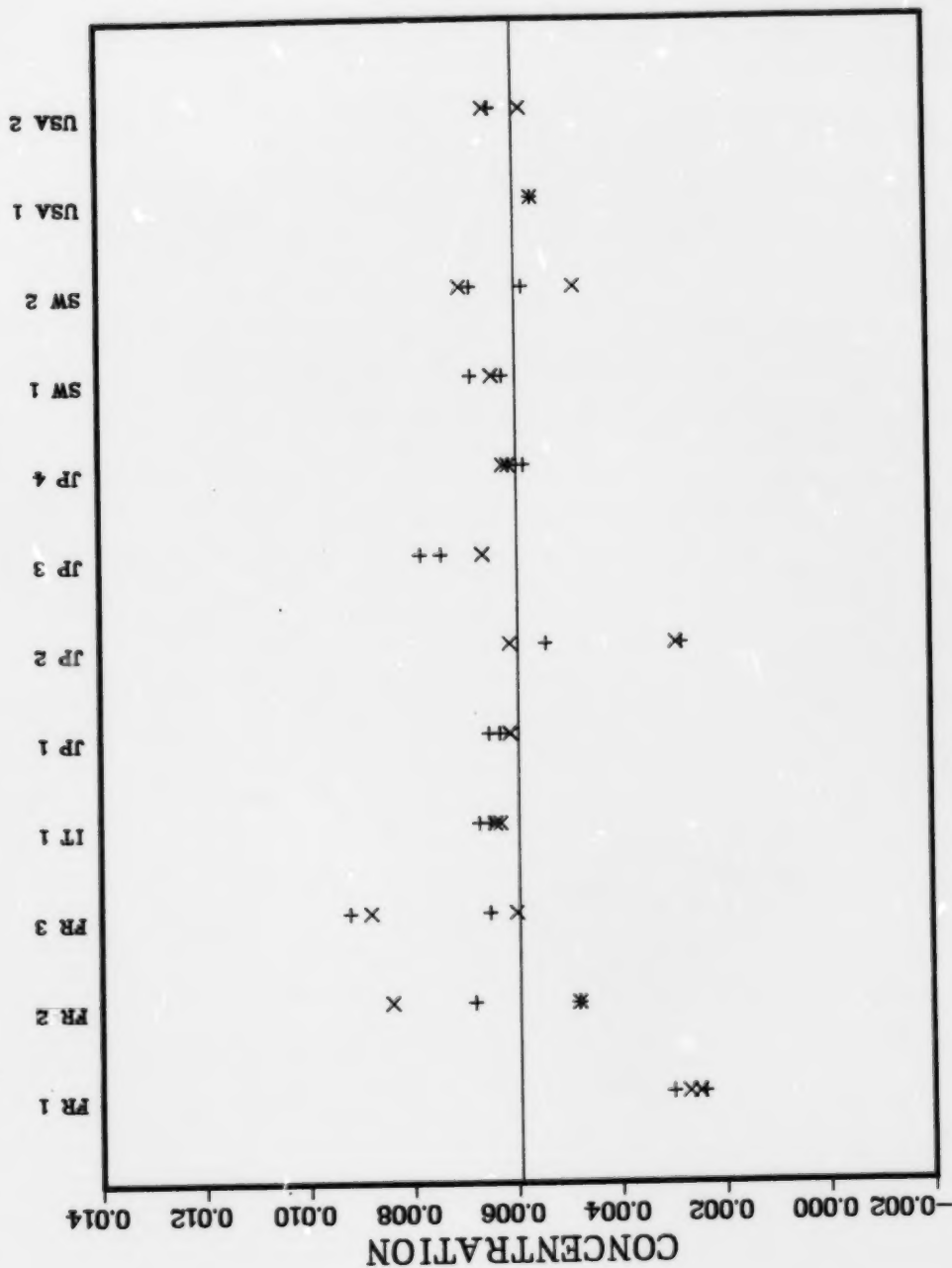
Figure 2.5



IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 79-14

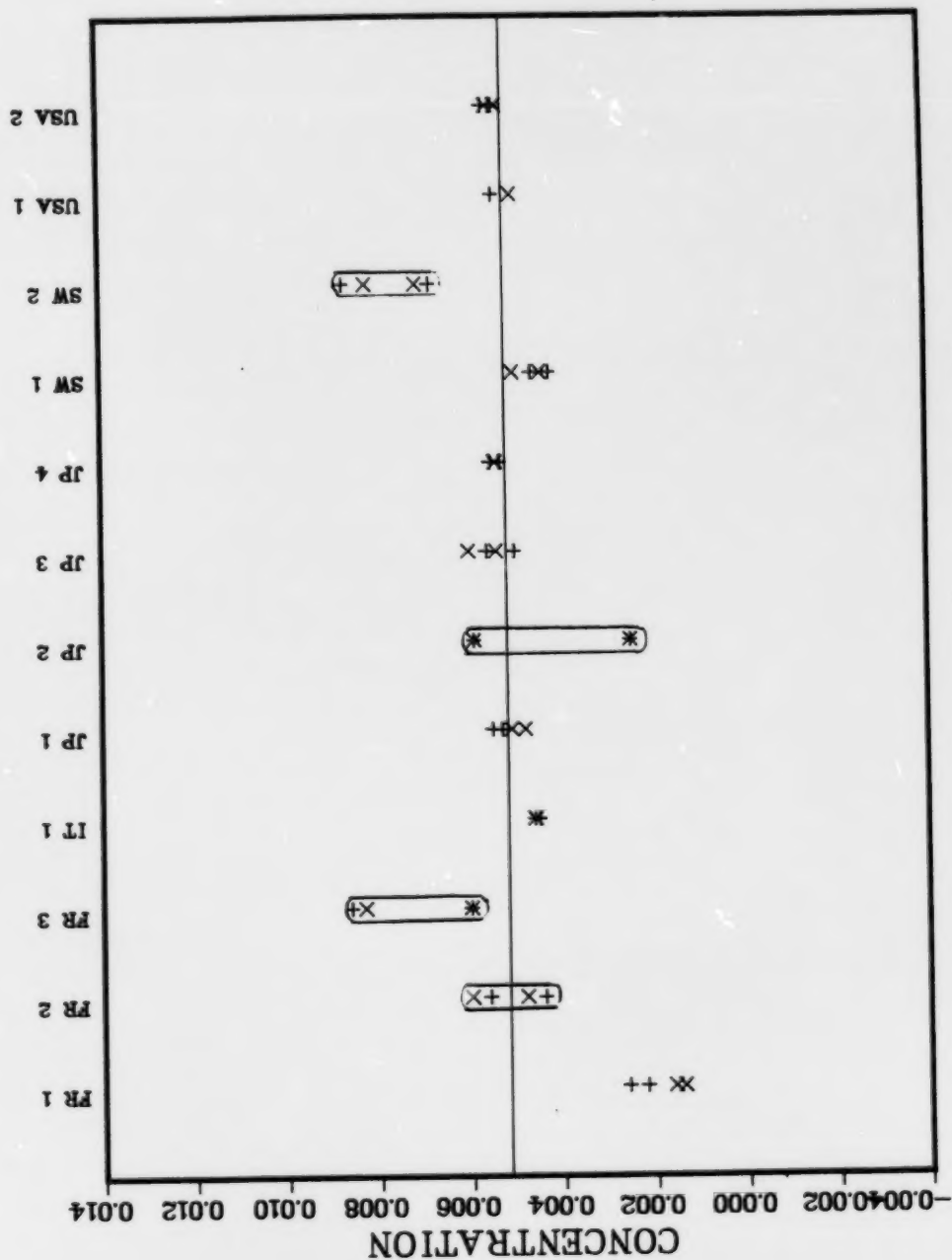
Figure 2.6



IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 79-16

Figure 2.7



IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

SAMPLE 79-17

Figure 2.8

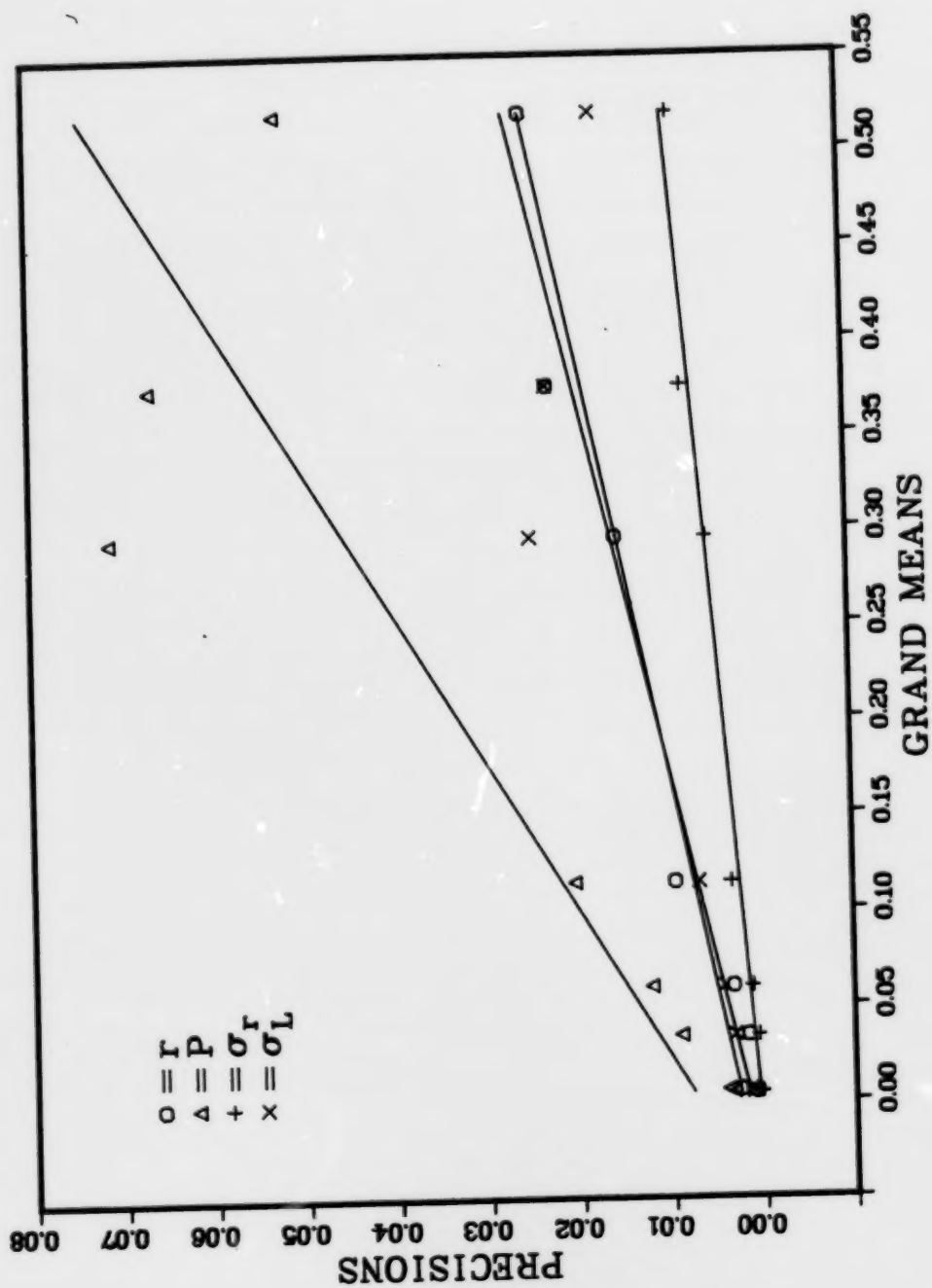


Figure 3.1
IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

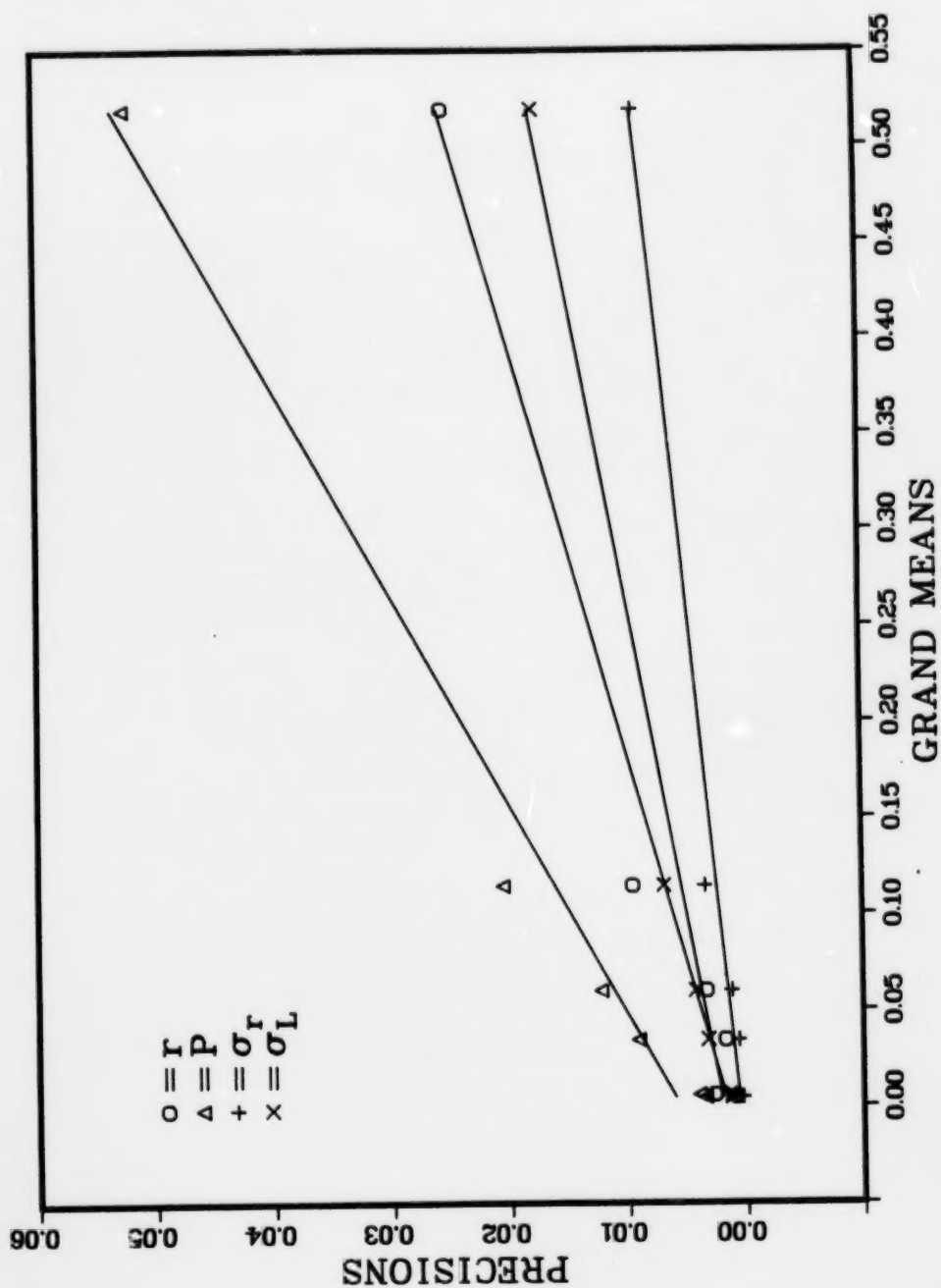


Figure 3.2
IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5

APPENDIX A

DETAILED COMPUTATION OF THE ANALYTICAL DATA

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 76-3

LABORATORY BOTTLE ANALYTICAL RESULTS			LAB	LAB
NO.	COUNTRY	NO.	MEAN	VARIANCE
1	FR 1	1	.2860	.2900
		2	.2820	.2980
2	FR 2	1	.2700	.2800
		2	.2780	.2860
3	FR 3	1	.2423	.2377
		2	.2346	.2366
4	IT 1	1	.3260	.3250
		2	.3170	.3200
5	JP 1	1	.3125	.3155
		2	.3110	.3123
6	JP 2	1	.2745	.2631
		2	.2760	.2662
7	JP 3	1	.3162	.3122
		2	.3232	.3122
8	JP 4	1	.3032	.3125
		2	.3064	.3136
9	SW 1	1	.3160	.3080
		2	.3020	.3140
10	SW 2	1	.3660	.2824
		2	.3113	.3302
11	USA 1	1	.3097	.2923
		2	.2945	.3015
12	USA 2	1	.3049	.3100
		2	.3010	.3076

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC 102/SC 2/WG 198-5
SAMPLE 75-3

BARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	36.959
CHI-SQUARE(.95,23)	35.178
VARIANCE IS INHOMOGENEOUS	

COCHRAN'S TEST FOR BOTTLE VARIANCE

LAB-10	BOTTLE- 1	C-CALC = .780	C-CRIT(2,24) = .344
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DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB-10	COCHRAN'S TEST FOR BOTTLE VARIANCE
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IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 74-3

TWO-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	10	.24992276E-01	.24992276E-02
BETWEEN BOTTLES	11	.18396750E-03	.16724318E-04
WITHIN BOTTLES	22	.80625500E-03	.36647955E-04
TOTAL	43	.25992499E-01	

F-CALC = .456 F-CRIT(.95;11,22) = 2.259

TEST SAMPLE IS HOMOGENEOUS

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 76-3

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	44.024
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB-10 C-CALC = .788 C-CRIT(4,12) = .326

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB-10 COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISD/TC102/SC2/WG 198-5
SAMPLE 75-3

ONE-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	10	.24992276E-01	.24992276E-02
WITHIN LABS	33	.9902225CE-03	.30006742E-04
TOTAL	43	.25982499E-01	

REPEATABILITY VARIANCE	.30006742E-04
REPEATABILITY STD. DEV.	.00547784

BETWEEN-LABORATORIES VARIANCE	.61730522E-03
BETWEEN-LABORATORIES STD. DEV.	.02484563

REPEATABILITY	.01550229
PERMISSIBLE TOLERANCE BETWEEN LABS	.07116246

GRAND MEAN	.29548409
VARIANCE OF THE GRAND MEAN	.56800628E-04

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 76-17

LABORATORY			ANALYTICAL RESULTS		LAB	LAB
NO.	COUNTRY	BOTTLE NO.			MEAN	VARIANCE
1	FR 1	1	.4890	.5040	.48825	.1389E-03
		2	.4760	.4840		
2	FR 2	1	.5280	.5000	.50850	.2837E-03
		2	.5160	.4900		
3	FR 3	1	.5506	.5283	.53979	.2045E-03
		2	.5536	.5266		
4	IT 1	1	.5210	.5160	.51475	.2358E-04
		2	.5120	.5100		
5	JP 1	1	.5238	.5264	.52353	.4716E-05
		2	.5226	.5213		
6	JP 2	1	.5858	.5353	.55450	.1010E-02
		2	.5768	.5201		
7	JP 3	1	.5250	.5310	.53050	.1700E-04
		2	.5310	.5350		
8	JP 4	1	.5200	.5300	.52550	.1916E-04
		2	.5242	.5278		
9	SW 1	1	.5000	.5000	.49850	.3667E-05
		2	.4960	.4980		
10	SW 2	1	.5620	.5313	.53585	.7309E-03
		2	.5000	.5501		
11	USA 1	1	.5231	.5433	.54315	.5682E-03
		2	.5296	.5766		
12	USA 2	1	.5415	.5415	.54010	.1125E-04
		2	.5351	.5423		

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 75-17

BARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	23.696
CHI-SQUARE(.95,19)	30.148

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB- 9	ZERO WITHIN-BOTTLE VARIANCE
LAB-12	ZERO WITHIN-BOTTLE VARIANCE

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 76-17

TWO-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION -----	D.F. ----	SUM OF SQUARES -----	MEAN SQUARE -----
BETWEEN LABS	9	.13103189E-01	.14559099E-02
BETWEEN BOTTLES	10	.14948250E-02	.14948250E-03
WITHIN BOTTLES	20	.75061900E-02	.37530950E-03
TOTAL	39	.22104204E-01	

F-CALC = .398 F-CRIT(.95;10,20) = 2.348

TEST SAMPLE IS HOMOGENEOUS

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 76-17

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	43.765
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 6	C-CALC = .335	C-CRIT(4,12) = .326
LAB-10	C-CALC = .364	C-CRIT(4,11) = .348
LAB-11	C-CALC = .446	C-CRIT(4,10) = .373

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 6	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-10	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-11	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC 102/SC 2/WG 198-5
SAMPLE 76-17

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION -----	D.F. ----	SUM OF SQUARES -----	MEAN SQUARE -----
BETWEEN LABS	8	.10262507E-01	.12828134E-02
WITHIN LABS	27	.21194550E-02	.78498333E-04
TOTAL	35	.12381962E-01	
REPEATABILITY VARIANCE		.78498333E-04	
REPEATABILITY STD. DEV.		.00885993	
BETWEEN-LABORATORIES VARIANCE		.30107877E-03	
BETWEEN-LABORATORIES STD. DEV.		.01735162	
REPEATABILITY		.02507360	
PERMISSIBLE TOLERANCE BETWEEN LABS		.05220778	
GRAND MEAN		.51882222	
VARIANCE OF THE GRAND MEAN		.35633706E-04	

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 91-3

LABORATORY BOTTLE ANALYTICAL RESULTS			LAB LAB	
NO.	COUNTRY	NO.	MEAN	VARIANCE
1	FR 1	1	.3770	.3580
		2	.3600	.3700
2	FR 2	1	.3700	.3500
		2	.3500	.3400
3	FR 3	1	.3363	.3345
		2	.3199	.3272
4	IT 1	1	.3970	.3950
		2	.3880	.3900
5	JP 1	1	.3958	.3914
		2	.3914	.3899
6	JP 2	1	.3990	.3312
		2	.3930	.3250
7	JP 3	1	.4037	.4077
		2	.4127	.4137
8	JP 4	1	.3899	.3928
		2	.3899	.3945
9	SW 1	1	.3760	.3560
		2	.3560	.3700
10	SW 2	1	.4420	.4000
		2	.4005	.4422
11	USA 1	1	.3827	.3758
		2	.3591	.3868
12	USA 2	1	.3747	.3770
		2	.3857	.3691

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE P1-3

BARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	39.857
CHI-SQUARE(.95,23)	35.178

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR BOTTLE VARIANCE

NONE REJECTED

DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

ALL RESULTS WERE USED

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-3

TWO-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
-----	----	-----	-----
BETWEEN LABS	11	.28150637E-01	.25591488E-02
BETWEEN BOTTLES	12	.57477250E-03	.47897708E-04
WITHIN BOTTLES	24	.77545950E-02	.32310813E-03
TOTAL	47	.36480005E-01	

F-CALC = .148 F-CRIT(.95;12,24) = 2.183

TEST SAMPLE IS HOMOGENEOUS

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-3

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	40.692
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 6	C-CALC = .558	C-CRIT(4,12) = .326
LAB-10	C-CALC = .476	C-CRIT(4,11) = .348

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 6	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-10	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

JPCN ORFS - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-3

ONE-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	9	.19347954E-01	.21497727E-02
WITHIN LABS	30	.19301700E-02	.64339000E-04
TOTAL	39	.21278124E-01	

REPEATABILITY VARIANCE	.64339000E-04
REPEATABILITY STD. DEV.	.00802116

BETWEEN-LABORATORIES VARIANCE	.52135842E-03
BETWEEN-LABORATORIES STD. DEV.	.02283327

REPEATABILITY	.02269988
PERMISSIBLE TOLERANCE BETWEEN LABS	.06658190

GRAND MEAN	.37513000
VARIANCE OF THE GRAND MEAN	.53744317E-04

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-4

LABORATORY BOTTLE ANALYTICAL RESULTS			LAB LAB	
NO.	COUNTRY	NO.	MEAN	VARIANCE
1	FR 1	1	.1095	.1080
		2	.1040	.1080
2	FR 2	1	.1180	.1120
		2	.1170	.1090
3	FR 3	1	.1135	.1062
		2	.1248	.1085
4	IT 1	1	.1100	.1150
		2	.1090	.1050
5	JP 1	1	.1147	.1137
		2	.1162	.1162
6	JP 2	1	.1289	.1220
		2	.1258	.1220
7	JP 3	1	.1163	.1196
		2	.1183	.1173
8	JP 4	1	.1147	.1159
		2	.1195	.1196
9	SW 1	1	.1000	.1080
		2	.1100	.1050
10	SW 2	1	.1102	.1025
		2	.1000	.1040
11	USA 1	1	.1208	.1298
		2	.1185	.1246
12	USA 2	1	.1207	.1212
		2	.1201	.1203

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE R1-4

PARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	22.872
CHI-SQUARE(.95,21)	32.678

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DOORNBOOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB- 5 ZERO WITHIN-BOTTLE VARIANCE

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISJ/TC102/SC2/WG 19B-5
SAMPLE 81-4

TWO-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION -----	D.F. ---	SUM OF SQUARES -----	MEAN SQUARE -----
BETWEEN LABS	10	.19928418E-02	.19928418E-03
BETWEEN BOTTLES	11	.15433750E-03	.14030682E-04
WITHIN BOTTLES	22	.41820500E-03	.19009318E-04
TOTAL	43	.25653843E-02	

F-CALC = .738 F-CRIT(.95;11,22) = 2.259

TEST SAMPLE IS HOMOGENEOUS

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-4

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	23.203
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 3 C-CALC = .357 C-CRIT(4,12) = .326

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 3 COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON DRES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISD/TC102/SC2/WG 198-5
SAMPLE 81-4

ONE-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	10	.19889064E-02	.19889064E-03
WITHIN LABS	33	.37131250E-03	.11251894E-04
TOTAL	43	.23602189E-02	

REPEATABILITY VARIANCE	.11251894E-04
REPEATABILITY STD. DEV.	.00335438

BETWEEN-LABORATORIES VARIANCE	.46909686E-04
BETWEEN-LABORATORIES STD. DEV.	.00684906

REPEATABILITY	.00949291
PERMISSIBLE TOLERANCE BETWEEN LABS	.02051226

GRAND MEAN	.11456591
VARIANCE OF THE GRAND MEAN	.45202417E-05

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-5

LABORATORY BOTTLE ANALYTICAL RESULTS			LAB	
NO.	COUNTRY	NO.	MEAN	VARIANCE
1	FR 1	1	.0494	.0492
		2	.0488	.0492
2	FR 2	1	.0620	.0580
		2	.0600	.0580
3	FR 3	1	.0629	.0607
		2	.0649	.0622
4	IT 1	1	.0610	.0617
		2	.0604	.0610
5	JP 1	1	.0617	.0617
		2	.0637	.0627
6	JP 2	1	.0656	.0590
		2	.0636	.0577
7	JP 3	1	.0612	.0624
		2	.0636	.0604
8	JP 4	1	.0615	.0613
		2	.0617	.0607
9	SW 1	1	.0584	.0580
		2	.0592	.0560
10	SW 2	1	.0620	.0532
		2	.0510	.0464
11	USA 1	1	.0607	
		2	.0612	
12	USA 2	1	.0631	.0648
		2	.0640	.0631

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-5

BARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	24.419
CHI-SQUARE(.95,19)	30.148

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB- 5	ZERO WITHIN-BOTTLE VARIANCE
LAB-11	NUMBER OF BOTTLES OR REPLICATES INCORRECT

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-5

TWO-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	9	.76946525E-03	.85496139E-04
BETWEEN BOTTLES	10	.87107500E-04	.87107500E-05
WITHIN BOTTLES	20	.11848500E-03	.59242500E-05
TOTAL	39	.97505775E-03	

F-CALC = 1.470 F-CRIT(.95;10,20) = 2.348

TEST SAMPLE IS HOMOGENEOUS

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5
SAMPLE 81-5

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	45.607
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB-10	C-CALC = .616	C-CRIT(4,12) = .326
LAB- 6	C-CALC = .522	C-CRIT(4,11) = .348

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 6	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-10	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 81-5

ONE-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	9	.62561342E-03	.69512602E-04
WITHIN LABS	28	.38050000E-04	.13589286E-05
TOTAL	37	.66366342E-03	

REPEATABILITY VARIANCE
REPEATABILITY STD. DEV.

.13589286E-05
.00116573

BETWEEN-LABORATORIES VARIANCE
BETWEEN-LABORATORIES STD. DEV.

.17984997E-04
.00424087

REPEATABILITY
PERMISSIBLE TOLERANCE BETWEEN LABS

.00329902
.01222628

GRAND MEAN
VARIANCE OF THE GRAND MEAN

.06001316
.18790989E-05

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-14

LABORATORY BOTTLE ANALYTICAL RESULTS			LAB	LAB
NO.	COUNTRY	NO.	MEAN	VARIANCE
1	FR 1	1	.0290	.0292
		2	.0285	.0298
2	FR 2	1	.0370	.0350
		2	.0370	.0330
3	FR 3	1	.0363	.0344
		2	.0344	.0359
4	IT 1	1	.0352	.0356
		2	.0350	.0350
5	JP 1	1	.0356	.0363
		2	.0349	.0345
6	JP 2	1	.0379	.0323
		2	.0373	.0321
7	JP 3	1	.0358	.0362
		2	.0374	.0372
8	JP 4	1	.0362	.0354
		2	.0358	.0356
9	SW 1	1	.0292	.0290
		2	.0296	.0296
10	SW 2	1	.0256	.0284
		2	.0312	.0282
11	USA 1	1	.0371	
		2	.0375	
12	USA 2	1	.0379	.0381
		2	.0368	.0378

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-14

PARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	23.476
CHI-SQUARE(.95,17)	27.593

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB- 4	ZERO WITHIN-BOTTLE VARIANCE
LAB- 9	ZERO WITHIN-BOTTLE VARIANCE
LAB-11	NUMBER OF BOTTLES OR REPLICATES INCORRECT

IRON NPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-14

TWO-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	8	.33911722E-03	.42389653E-04
BETWEEN BOTTLES	9	.12245000E-04	.13605556E-05
WITHIN BOTTLES	18	.52700000E-04	.29277778E-05
TOTAL	35	.40406222E-03	

F-CALC = .465 F-CRIT(.95; 9,18) = 2.456

TEST SAMPLE IS HOMOGENEOUS

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 19B-5
SAMPLE 79-14

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	35.364
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 6	C-CALC = .447	C-CRIT(4,12) = .326
LAB-10	C-CALC = .432	C-CRIT(4,11) = .348
LAB- 2	C-CALC = .533	C-CRIT(4,10) = .373

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 2	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB- 6	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-10	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-14

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
-----	----	-----	-----
BETWEEN LABS	8	.30865265E-03	.38581581E-04
WITHIN LABS	25	.94650000E-05	.37860000E-06
TOTAL	33	.31811765E-03	

REPEATABILITY VARIANCE	.37860000E-06
REPEATABILITY STD. DEV.	.00061530

BETWEEN-LABORATORIES VARIANCE	.10147667E-04
BETWEEN-LABORATORIES STD. DEV.	.00318554

REPEATABILITY	.00174131
PERMISSIBLE TOLERANCE BETWEEN LABS	.00909878

GRAND MEAN	.03446471
VARIANCE OF THE GRAND MEAN	.11698654E-05

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-16

LABORATORY BOTTLE ANALYTICAL RESULTS			LAB	
NO.	COUNTRY	NO.	MEAN	VARIANCE
1	FR 1	1	.0027	.0025
		2	.0030	.0024
2	FR 2	1	.0084	.0048
		2	.0068	.0048
3	FR 3	1	.0060	.0088
		2	.0065	.0092
4	IT 1	1	.0064	.0063
		2	.0067	.0065
5	JP 1	1	.0061	.0061
		2	.0065	.0063
6	JP 2	1	.0061	.0029
		2	.0054	.0028
7	JP 3	1	.0066	.0066
		2	.0074	.0078
8	JP 4	1	.0062	.0061
		2	.0058	.0061
9	SW 1	1	.0064	.0064
		2	.0062	.0068
10	SW 2	1	.0070	.0048
		2	.0068	.0058
11	USA 1	1	.0056	
		2	.0056	
12	USA 2	1	.0058	.0065
		2	.0064	.0064
			.00628	.1025E-06

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-16

BARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	18.087
CHI-SQUARE(.95,13)	22.367

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB- 5	ZERO WITHIN-BOTTLE VARIANCE
LAB- 7	ZERO WITHIN-BOTTLE VARIANCE
LAB- 9	ZERO WITHIN-BOTTLE VARIANCE
LAB-11	NUMBER OF BOTTLES OR REPLICATES INCORRECT
LAB-12	ZERO WITHIN-BOTTLE VARIANCE

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
 SAMPLE 79-16

TWO-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LARS	6	.64262143E-04	.10710357E-04
BETWEEN BOTTLES	7	.12750000E-05	.18214286E-06
WITHIN BOTTLES	14	.27740000E-04	.19814286E-05
TOTAL	27	.93277143E-04	

F-CALC = .092 F-CRIT(.95; 7,14) = 2.764

TEST SAMPLE IS HOMOGENEOUS

IRON PRES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 77-16

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	40.461
CHI-SQUARE(.95,10)	18.311

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

NONE REJECTED

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-16

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	11	.74464674E-04	.67695158E-05
WITHIN LABS	34	.30702500E-04	.90301471E-06
TOTAL	45	.10516717E-03	

REPEATABILITY VARIANCE	.90301471E-06
REPEATABILITY STD. DEV.	.00095027

BETWEEN-LABORATORIES VARIANCE	.15332901E-05
BETWEEN-LABORATORIES STD. DEV.	.00123826

REPEATABILITY	.00268927
PERMISSIBLE TOLERANCE BETWEEN LABS	.00398698

GRAND MEAN	.00593696
VARIANCE OF THE GRAND MEAN	.15006186E-06

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-17

LABORATORY			BOTTLE		ANALYTICAL RESULTS		LAB	LAB
NO.	COUNTRY	NO.					MEAN	VARIANCE
1	FR 1	1	.0014	.0016			.00195	.3033E-06
		2	.0026	.0022				
2	FR 2	1	.0060	.0048			.00520	.5333E-06
		2	.0056	.0044				
3	FR 3	1	.0060	.0083			.00723	.2016E-05
		2	.0060	.0086				
4	IT 1	1	.0046	.0046			.00458	.2500E-08
		2	.0045	.0046				
5	JP 1	1	.0051	.0048			.00518	.8917E-07
		2	.0055	.0053				
6	JP 2	1	.0059	.0025			.00420	.3853E-05
		2	.0059	.0025				
7	JP 3	1	.0054	.0060			.00550	.1733E-06
		2	.0056	.0050				
8	JP 4	1	.0054	.0054			.00540	.6667E-08
		2	.0053	.0055				
9	SW 1	1	.0044	.0050			.00455	.1167E-06
		2	.0042	.0046				
10	SW 2	1	.0082	.0071			.00770	.8067E-06
		2	.0087	.0068				
11	USA 1	1	.0050				.00520	.8000E-07
		2	.0054					
12	USA 2	1	.0053	.0055			.00545	.1667E-07
		2	.0056	.0054				

IRON OPES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISD/TC102/SC2/WG 198-5
SAMPLE 79-17

BARTLETT'S TEST FOR HOMOGENEITY OF BOTTLE VARIANCE

CALCULATED STATISTIC	20.445
CHI-SQUARE(.95,17)	27.593

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DOORNBOS' TEST FOR BOTTLE MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR TWO-WAY ANOVA

LAB- 4	ZERO WITHIN-BOTTLE VARIANCE
LAB- 8	ZERO WITHIN-BOTTLE VARIANCE
LAB-11	NUMBER OF BOTTLES OR REPLICATES INCORRECT

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-17

TWO-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	8	.89945000E-04	.11243125E-04
BETWEEN BOTTLES	9	.14657000E-05	.16277778E-06
WITHIN BOTTLES	18	.22260000E-04	.12366667E-05
TOTAL	35	.11367000E-03	

F-CALC = .132 F-CRIT(.95; 9,18) = 2.456

TEST SAMPLE IS HOMOGENEOUS

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-17

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	47.915
CHI-SQUARE(.95,11)	19.681

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 6	C-CALC = .482	C-CRIT(4,12) = .326
LAB- 3	C-CALC = .486	C-CRIT(4,11) = .348
LAB-10	C-CALC = .379	C-CRIT(4,10) = .373
LAB- 2	C-CALC = .404	C-CRIT(4, 9) = .403

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 2	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB- 3	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB- 6	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-10	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

IRON ORES - VANADIUM BY SPECTROPHOTOMETRIC METHOD, ISO/TC102/SC2/WG 198-5
SAMPLE 79-17

ONE-WAY ANALYSIS OF VARIANCE TABLE

<u>SOURCE OF VARIATION</u>	<u>D.F.</u>	<u>SUM OF SQUARES</u>	<u>MEAN SQUARE</u>
BETWEEN LABS	7	.38573667E-04	.55105238E-05
WITHIN LABS	22	.22050000E-05	.10022727E-06
TOTAL	29	.40778667E-04	

REPEATABILITY VARIANCE	.10022727E-06
REPEATABILITY STD. DEV.	.00031659

BETWEEN-LABORATORIES VARIANCE	.14491866E-05
BETWEEN-LABORATORIES STD. DEV.	.00120382

REPEATABILITY	.00089594
PERMISSIBLE TOLERANCE BETWEEN LABS	.00346522

GRAND MEAN	.00469333
VARIANCE OF THE GRAND MEAN	.19012496E-06

